through this valve (not shown) permit flow of fluids which, for example, may enter port 50, pass through chamber 60, go across valve 70, pass into chamber 62, and exit port 52. The holes 80*a*, 80*b*, 80*c* and 80*d* in side face 48 are for locating mounting bolts or suitable fasteners therethrough. It should be understood that the components described for diverter valve 70 are repeated for each of the other four diverter valves in the valve assembly.

Possible fluid flow paths in the valve assembly of the instant invention are depicted in FIGS. 4A–4C. In the preferred embodiment described below, port 50 is connected to an inlet process piping system (not shown) and functions as an inlet port. Port 54 is connected to an outlet process piping system (not shown) and functions as an outlet port. Ports 52 and 56 are connected to a chromatography column (not shown) and function as either inlet or outlet ports to this column depending on the direction of fluid flow. The flow in these figures is represented by arrows 100.

Referring now to FIG. 4A, fluid, containing the product or products to be analyzed, flows from the process piping in a forward direction through port 50, into chamber 60, across valve 76, into chamber 66, and out port 56 to a chromatography column. The fluid returns from the chromatography column entering the valve assembly through port 52, into chamber 62, across valve 72, into chamber 64, and out of the assembly to the outlet process piping through port 54. Since chambers 60, 62, 64 and 66 are common to two valves respectively (72 and 76), the fluid being piped through each port (50, 52, 54, 56) will flush and sweep through the chamber preventing stagnation and the opportunity for contaminants or particulates to accumulate and/or growth of microorganisms to develop.

Referring now to FIG. 4B, there is shown the product flow through the chromatography valve assembly in a reverse direction with respect to the flow depicted in FIG. 4A. Product here flows from the inlet process piping into the valve assembly 30 via port 50, into chamber 60, across valve 70, into chamber 62, and out port 52 into a chromatography column. Product returns from the chromatography column entering the valve assembly 30 through port 56, into chamber 66, across valve 74, into chamber 64, and out to the outlet process piping through port 54. As in the case where the fluid is flowing in a forward direction, chambers 60, 62, 64 and 66 are common to two valves respectively (this time 70 and 74), and the fluid being piped through each port (50, 52, 54, 56) will flush and sweep through the chamber preventing stagnation and the opportunity for contaminants or particulates to accumulate and/or growth of microorganisms to develop.

The chromatography column may be bypassed altogether as is depicted in FIG. 4C. According to this process flow, liquid enters the valve assembly 30 through port 50 and passes into chamber 60. The fluid then crosses valve 78 and passes into chamber 64. From chamber 64 the fluid exits the valve assembly 30 through port 54. During the column bypassing process, valves 70, 72, 74 and 76 remain closed, and fluid remaining in chambers 62 and 66 (as well as in the column) remains undisturbed in the process.

The valve assembly 30 described herein is simple and easy to use, and represents an improvement over prior art diverter valve assemblies. The device is machined out of one block of material, and all flow compartments are shared and fully flushed when a flow through valve is opened, thereby eliminating dead-legs. The main body of the valve assembly (not including any manual bonnets) has an overall diameter of less than 4 inches with a height of less than 1½ inches and

internal piping diameters on the order of ½ inch, all of which make the instant device much more compact than the five or six independent valve assemblies of the prior art, thereby minimizing installation space. The afore-mentioned dimensions also make the valve assembly 30 easy to hold and assemble to a liquid chromatography system. In addition, the ½ inch diameter of the internal network of passageways and inlet/outlet ports is compatible with common liquid chromatography tubing dimensions. It should be understood, however, that the valve assembly and representative passageways can be manufactured in any size required. While the valve assembly 30 described herein is especially suited for use in liquid chromatography, it should also be understood that the device can be adapted for other uses as desired. It should further be understood that the embodiments described herein are merely exemplary and that a person skilled in the art may make many variations and modifications to the embodiments utilizing functionally equivalent elements to those described herein. Any and all such variations or modifications as well as others which may become apparent to those skilled in the art, are intended to be included within the scope of the invention as defined by the appended claims.

What is claimed is:

1. A unitarily formed diverter valve assembly for diverting the flow of fluids in a liquid chromatography system comprising;

a valve body;

first, second, third, and fourth ports;

first, second, third and fourth chambers; and

first, second, third, fourth and fifth diverter valves;

wherein said first port is associated with said first chamber, said second port is associated with said second chamber, said third port is associated with said third chamber, and said fourth port is associated with said fourth chamber; and

wherein said first diverter valve is disposed between said first and said second chamber such that a first side of said first diverter valve is positioned in said first chamber and a second side of said first diverter valve is positioned in said second chamber, said second diverter valve is disposed between said second and said third chamber such that a first side of said second diverter valve is positioned in said second chamber and a second side of said second diverter valve is positioned in said third chamber, said third diverter valve is disposed between said third and said fourth chamber such that a first side of said third diverter valve is positioned in said third chamber and a second side of said third diverter valve is positioned in said fourth chamber, said fourth diverter valve is disposed between said fourth and said first chamber such that a first side of said for diverter valve is positioned in said fourth chamber and a second side of said fourth diverter valve is positioned in said first chamber, and said fifth diverter valve is disposed between said first and said third chamber such that a first side of said fifth diverter valve is positioned in said first chamber and a second side of said fifth diverter valve is position and in said third chamber and wherein one of said first, second, third, fourth and fifth diverter valves is disposed at a predetermined highpoint in said valve body, relative to all other of said first, second, third, fourth and fifth diverter valves, and the other of said first, second, third, fourth and fifth diverter valves are disposed in said valve body at predetermined angles suitable for draining said valve assembly.

2. The diverter valve assembly of claim 1, wherein said valve body comprises an octahedral pyramid structure having:

a substantially planar, octagonally shaped base portion;

a substantially planar square top surface;

four distorted hexagonal side faces projecting downwardly from said square top surface; and,

four triangular faces rising perpendicularly from said base portion, said triangular faces being disposed between said four side faces.

3. The diverter valve assembly of claim 2, wherein said ports are disposed on said triangular faces.

4. The diverter valve assembly of claim 3, wherein said plurality of ports is equal to four ports.

5. The diverter valve assembly of claim 1, wherein at least two of said ports are connected to opposite sides of a chromatography column.

6. The diverter assembly of claim 1, wherein said predetermined angles are approximately 30° with respect to a base of the diverter valve assembly.

7. The diverter valve assembly of claim 1, further comprising a plurality of manual bonnets, each of said manual bonnets corresponding to one of said diverter valves which is disposed thereunder.

8. The diverter valve assembly of claim 7, wherein said manual bonnets operate to manually control the operation of said diverter valves.

9. The diverter valve assembly of claim 1, wherein fluid flowing in a first direction enters said valve assembly through said first port, passes through said first chamber, is directed across said first diverter valve into said second chamber, exits said valve assembly through said second port, reenters said valve assembly through said fourth port, passes through said fourth chamber, is directed across said third diverter valve, passes through said third chamber, and exists said valve assembly through said third port.

10. The diverter valve assembly of claim 9, wherein said second diverter valve operates to prevent fluid communication between said second and said third chamber, said fourth diverter valve operates to prevent fluid communication between said fourth and said first chamber, and said fifth diverter valve operates to prevent fluid communication between said first and said third chamber.

11. The diverter valve assembly of claim 1, wherein fluid flowing in a second direction enters said valve assembly through said first port, passes through said first chamber, is directed across said fourth diverter valve into said fourth chamber, exits said valve assembly through said fourth port, reenters said valve assembly through said second port, passes through said second chamber, is directed across said second diverter valve, passes through said third chamber, and exists said valve assembly through said third port.

12. The diverter valve assembly of claim 11, wherein said first diverter valve operates to prevent fluid communication between said first and said second chamber, said third diverter valve operates to prevent fluid communication between said third and said fourth chamber, and said fifth diverter valve operates to prevent fluid communication between said first and said third chamber.

13. The diverter valve assembly of claim 1, wherein fluid flowing in a third direction enters said valve assembly through said first port, passes through said first chamber, is directed across said fifth diverter valve into said third chamber, and exits said valve assembly through said third port.

14. The diverter valve assembly of claim 13, wherein said first diverter valve operates to prevent fluid communication between said first and said second chamber, said second diverter valve operates to prevent fluid communication between third and said second chamber, said fourth diverter valve operates to prevent fluid communication between said third and said fourth chamber, and said fourth diverter valve operates to prevent fluid communication between said first and said fourth chamber.

15. The valve assembly of claim 1, wherein said second port and said fourth port are connected to opposite ends of a chromatography column.

16. A diverter valve assembly for use in liquid chromatography comprising:

a unitarily formed valve body comprising an octahedral pyramid structure having: a substantially planar, octagonally shaped base portion; a substantially planar square top surface; four distorted hexagonal side faces projecting downwardly from said square top surface; and four triangular faces rising perpendicularly from said base portion, said triangular faces being disposed between said four side faces;

a plurality of ports in said valve body, at least one of said plurality of ports functioning as an inlet port for allowing a liquid to enter into said valve body, at least one other of said plurality of ports functioning as an outlet port for allowing said liquid to exit said valve body, and at least two other of said plurality of ports each operable in a first inlet mode and a second outlet mode respectively, with respect to said valve body;

a plurality of chambers in said valve body, each one of said chambers being associated with one of said ports;

a tortuous network of channels communicating between said ports in said valve body for directing the flow of said liquid through said valve body; and,

a plurality of diverter valves located in said valve body, said diverter valves operating to control the flow of said liquid in said valve body, one of said plurality of diverter valves disposed at a predetermined highpoint in said valve body, relative to all other of said plurality of diverter valves, and the other of said plurality of diverter valves disposed in said valve body at approximately 30° angles with respect to a base of the diverter valve assembly, suitable for draining said valve assembly, wherein actuation of a predetermined combination of said ports, chambers, channels and diverter valves produces a smooth and unobstructed path for said liquid which substantially eliminates dead-legs in said valve assembly.